



North Pacific Oscillation and Its Association with SST Variations in Tropical Pacific

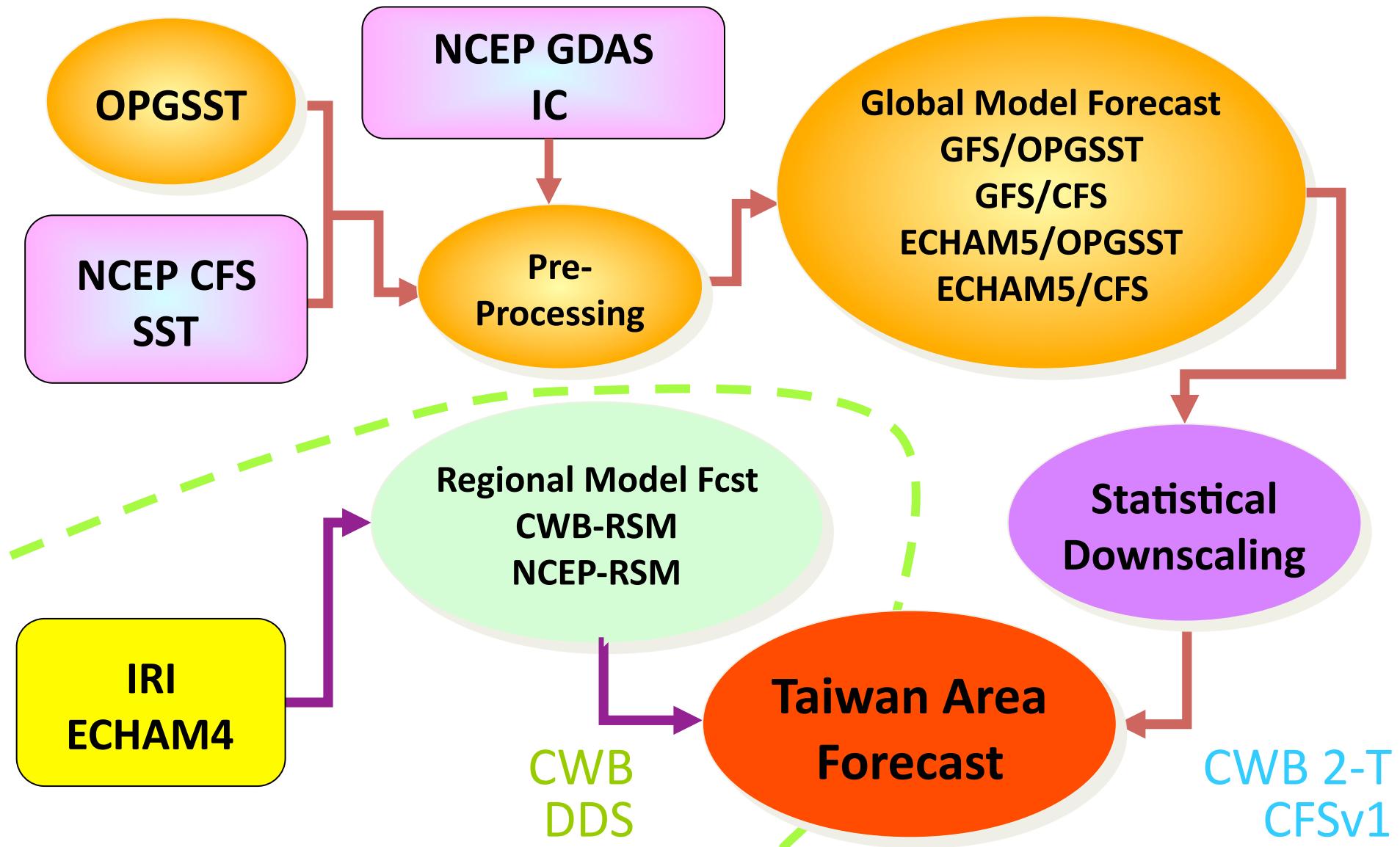
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氣象局氣候預報作業系統

CWB Climate Forecast Operational Systems

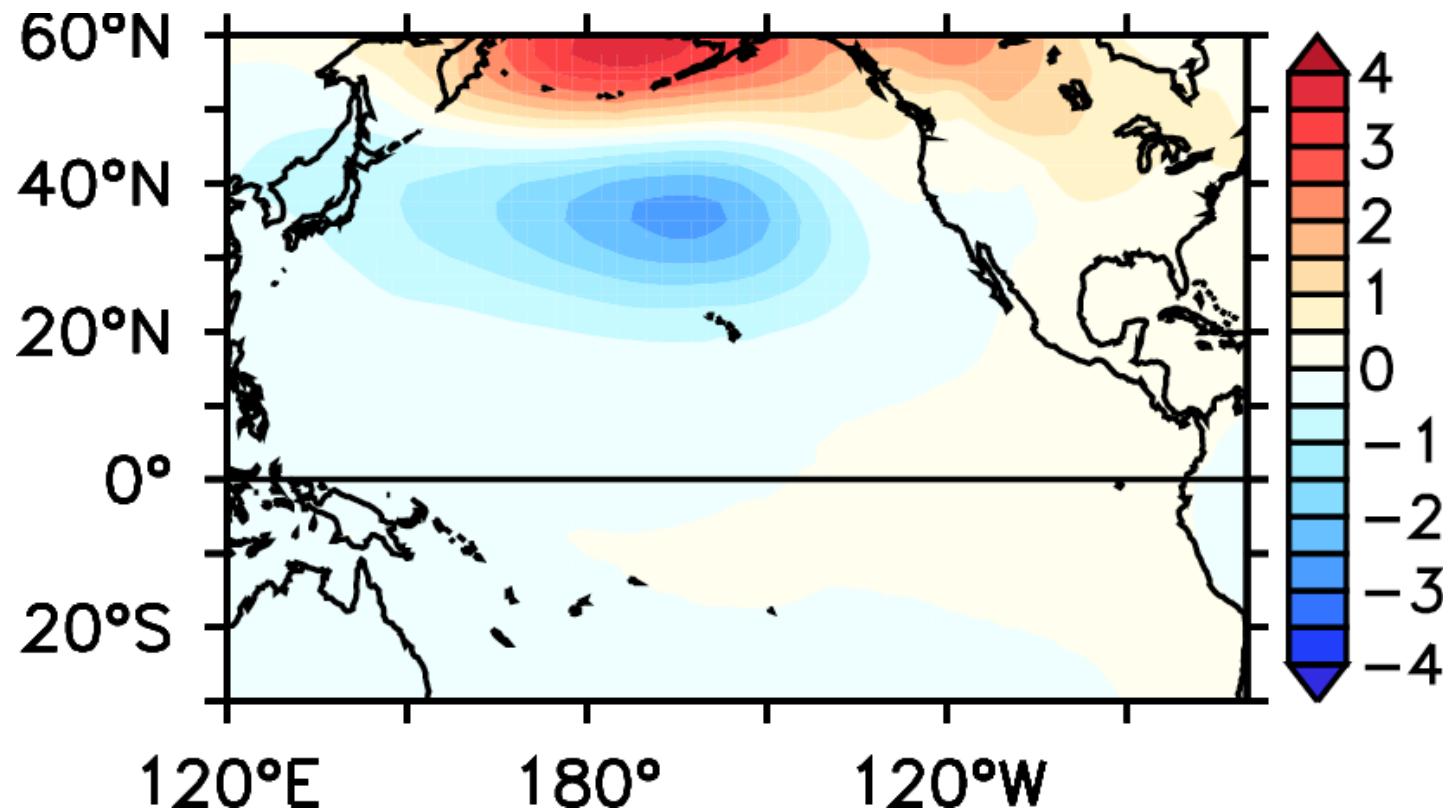


- The initial conditions used by CWB 2-tier Monthly-to-Seasonal Climate Forecast System for retrospective and operational forecasts are from NCEP.
- CWB is currently developing an *experimental* 1-tier climate forecast system. A new 1-tier operational CFS is planned to be built in 2016-2020. The required data assimilation for retrospective and operational forecasts are beyond what CWB can do. The future systems need to continue depending on NCEP CFS products.
- Understanding NCEP CFSv2 and CFSv3-to-be is essential for climate forecast capacity building at CWB.

Evaluating the **North Pacific Oscillation and Its Association with SST Variations in Tropical Pacific**
in CFSv2 decadal (30-yr) runs

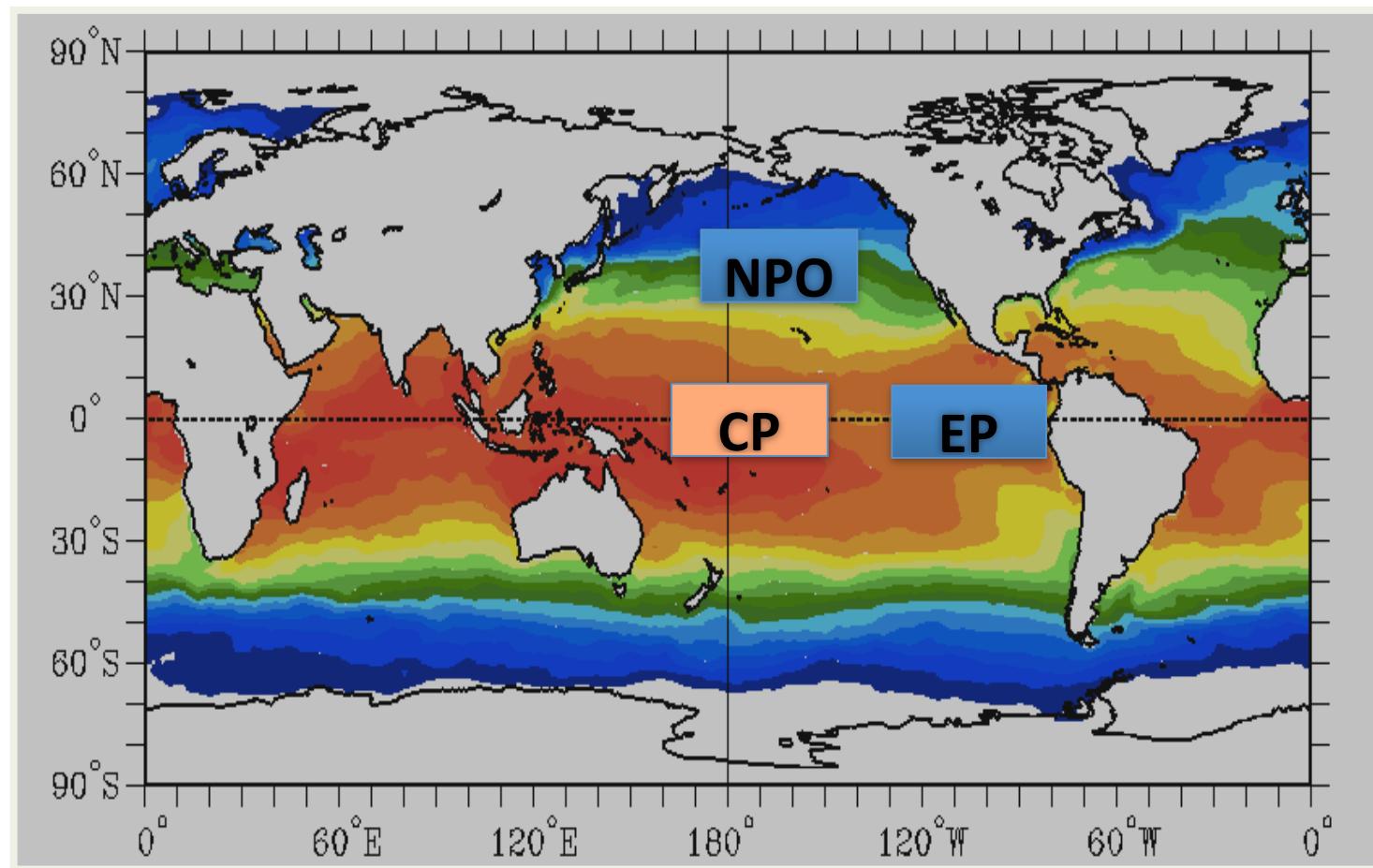
North Pacific Oscillation

(2nd EOF of SLP Anomalies over 20°N-60°N)



(Calculated from CFSR, 1979-2009)

NPO and Tropical Pacific SST Variations



Western North Pacific Tropical Cyclones and Two Types of ENSO

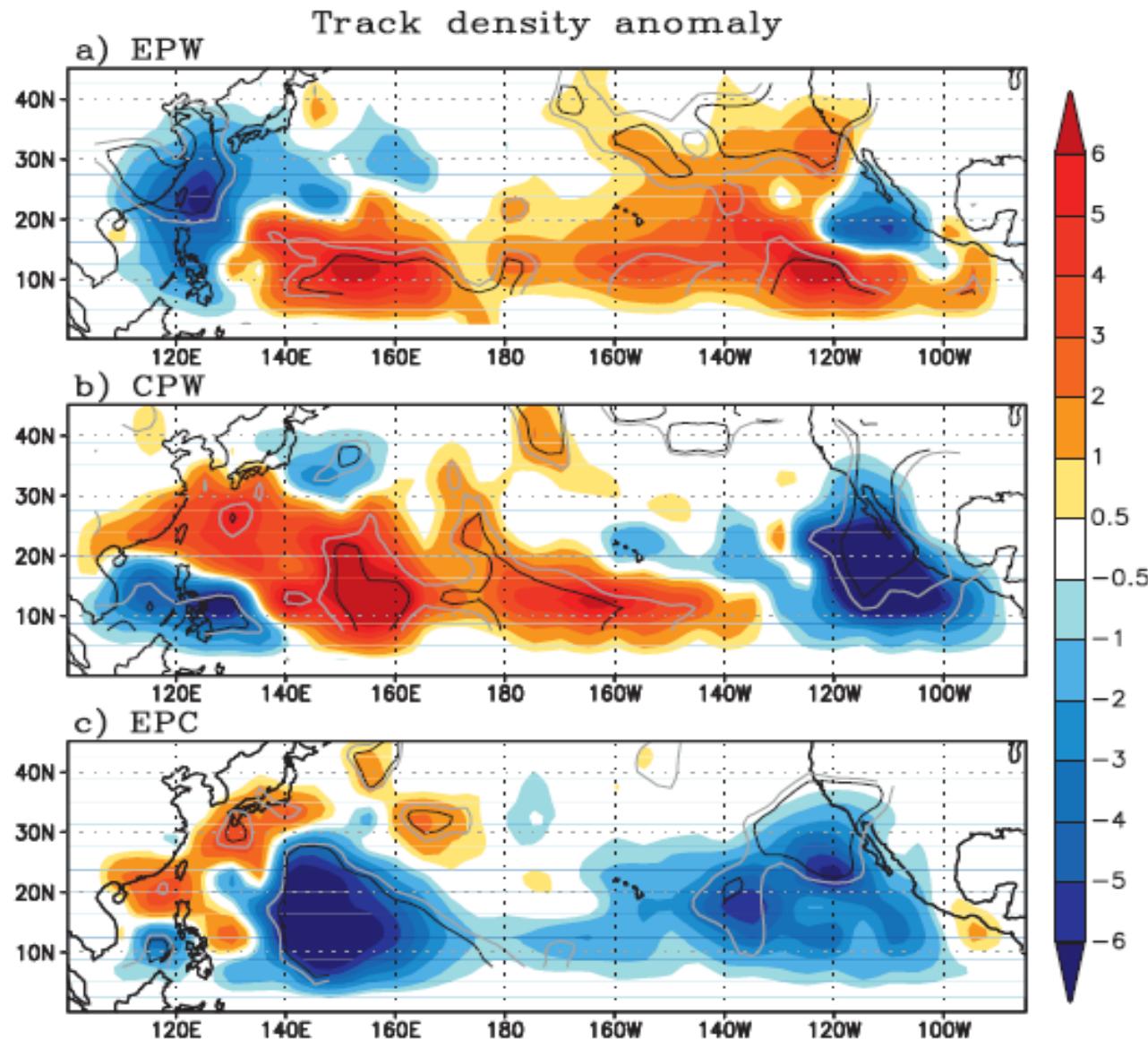
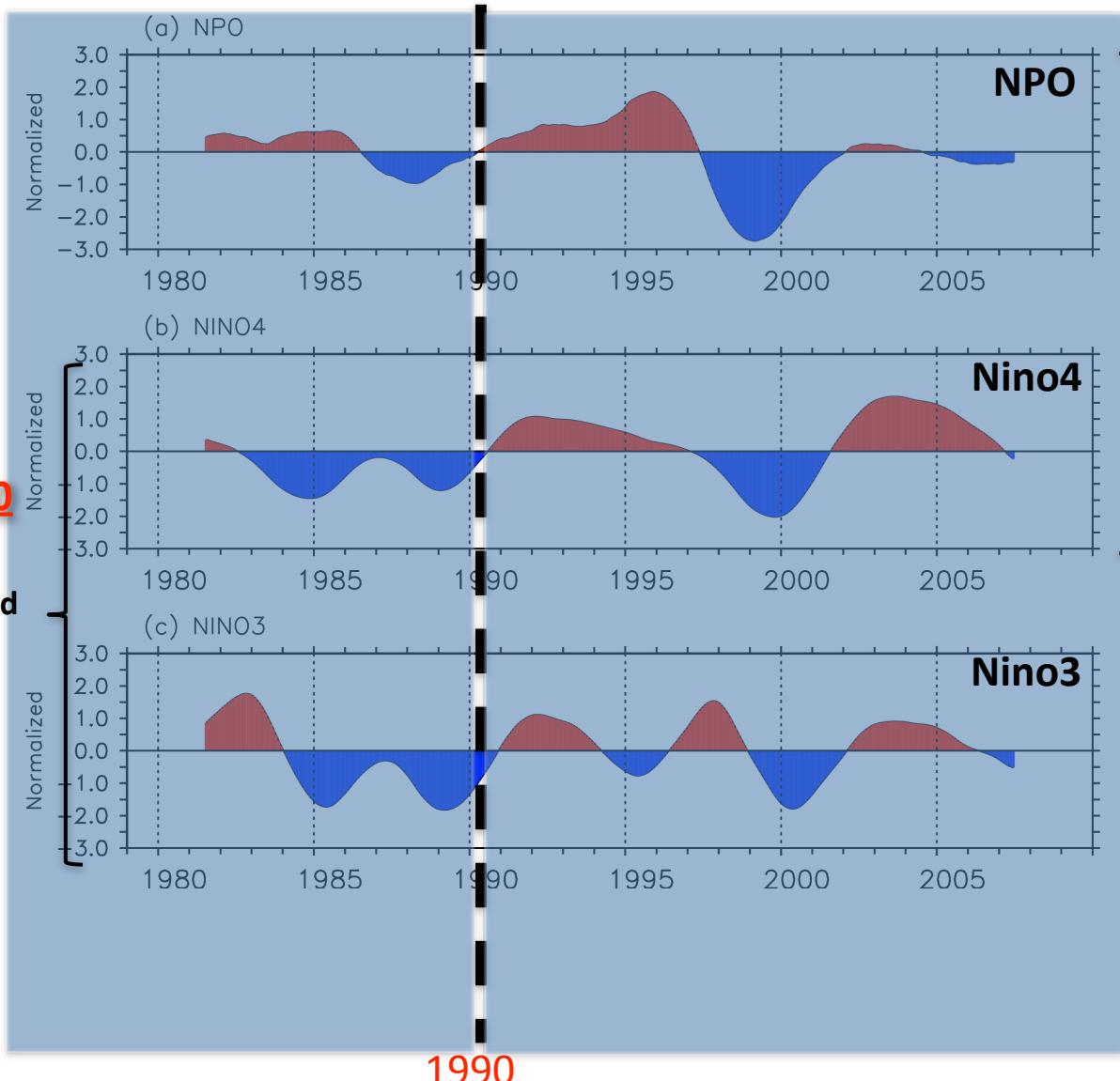


FIG. 5 Composites of track density anomalies in JASO for (a) EPW, (b) CPW, and (c) EPC years. Light (dark) contours show statistical significance at the 90% (95%) level. **(Kim, Webster, Curry 2011)**

NPO Index and NINO Index

(5-year running means)

1990



After 1990

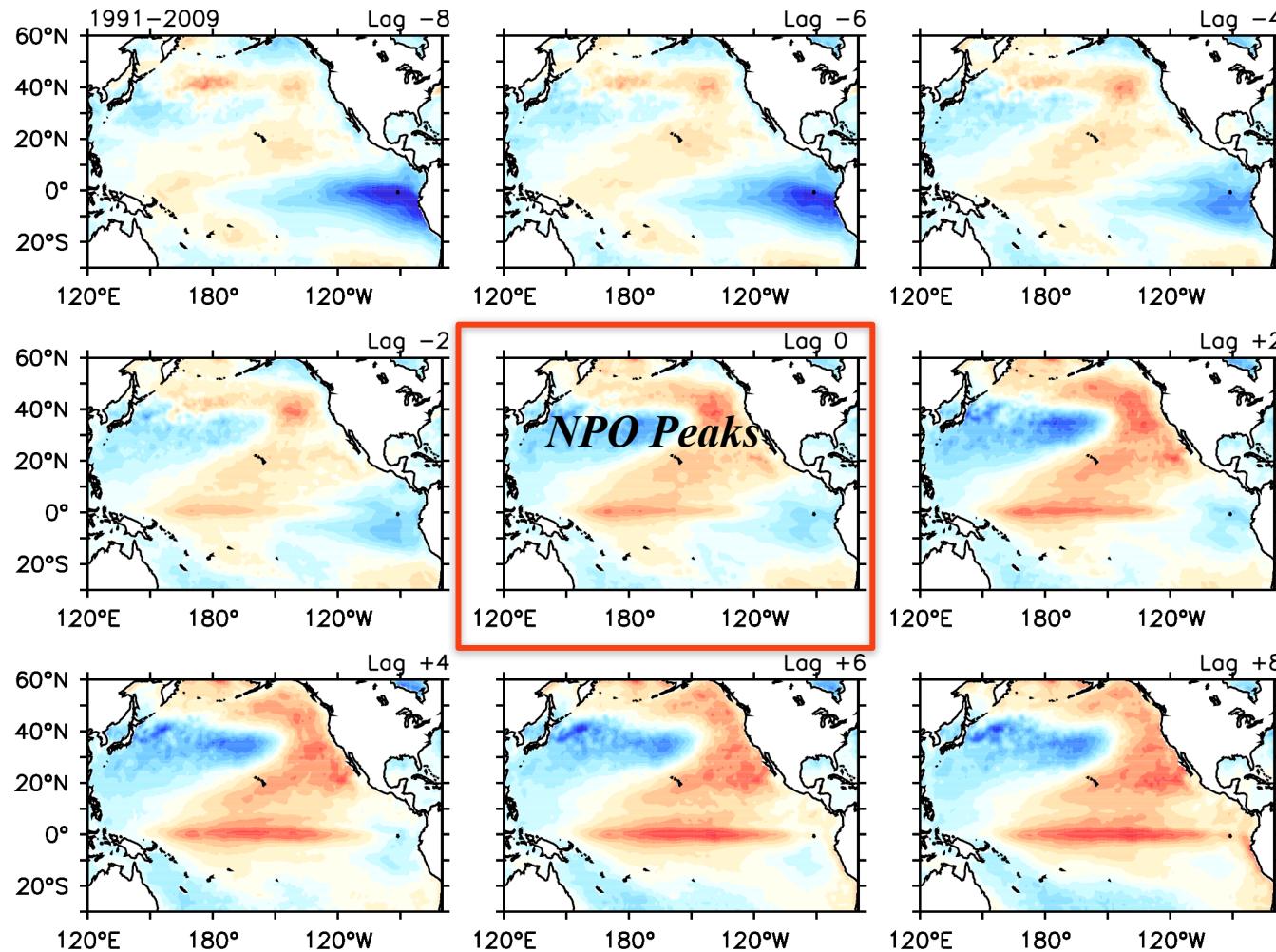
Central Pacific SSTA
is closely related to
Extratropical
atmosphere (i.e. NPO),
but less related
to eastern tropical
Pacific.

Before 1990

Central T. Pacific
SSTA is less related
to extratropical
atmosphere, but
more related to
eastern tropical
Pacific.

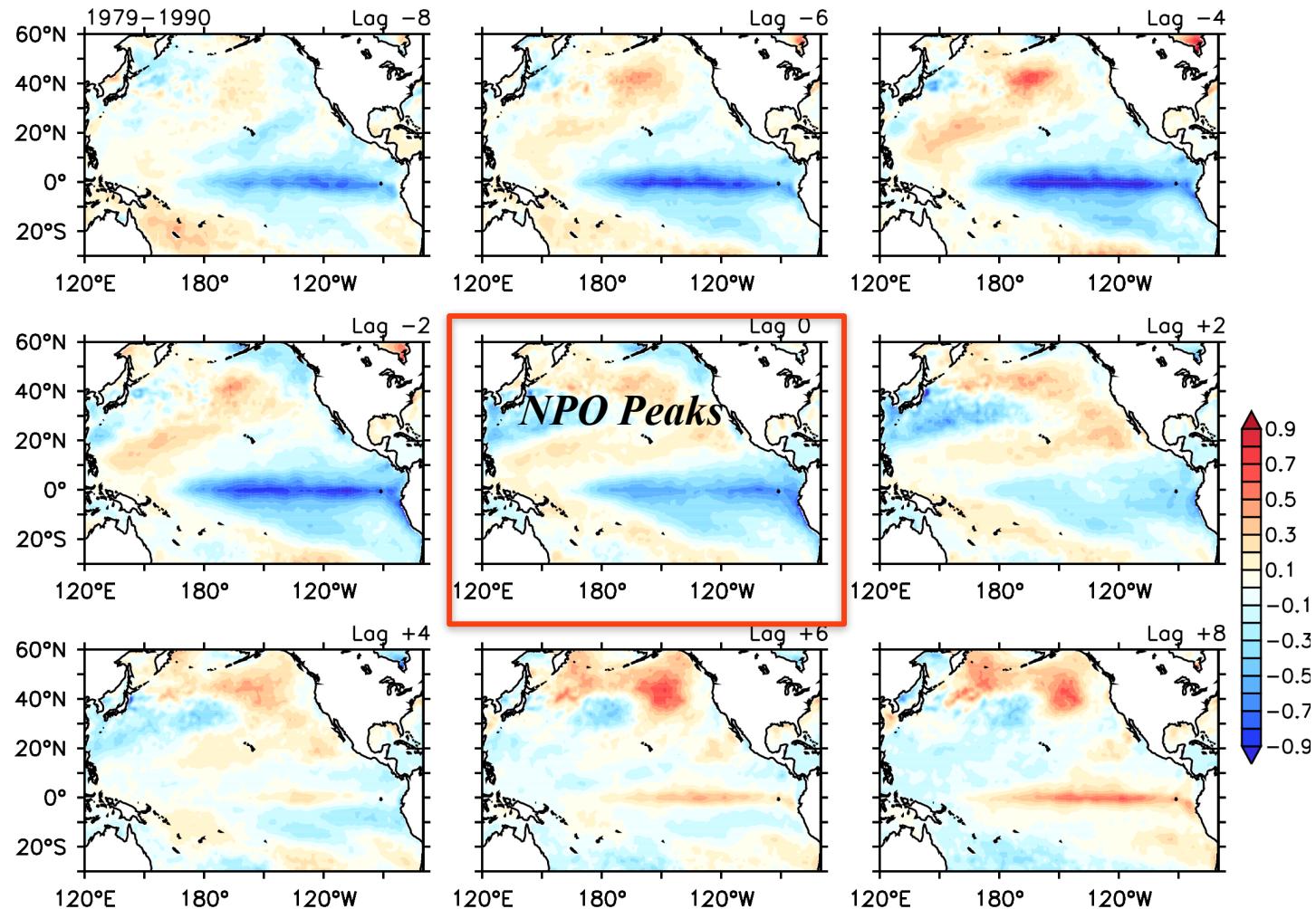
SST Anomalies Regressed onto NPO

after 1990 (1991-2009)

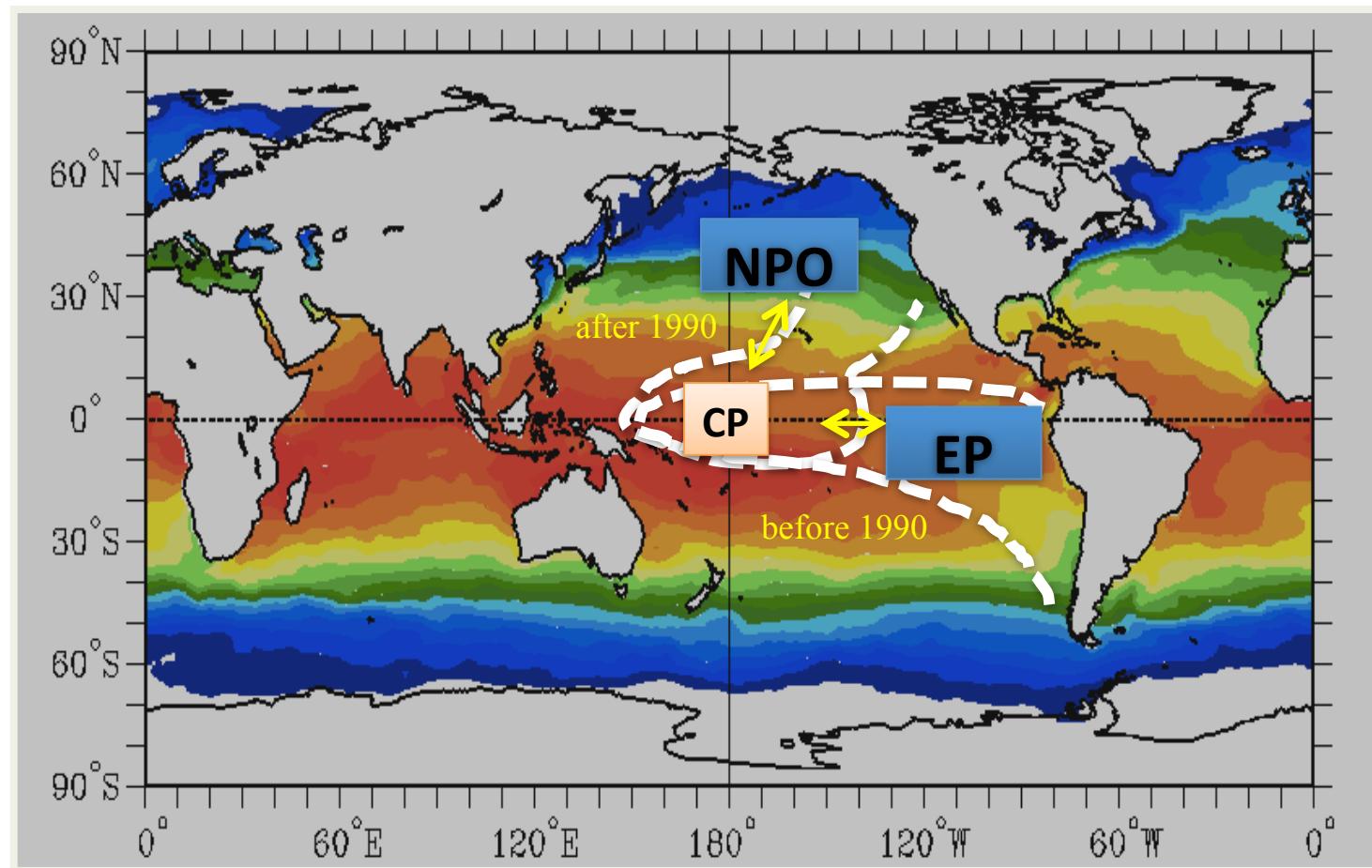


SSTA Regressed onto NPO

before 1990 (1979-1990)



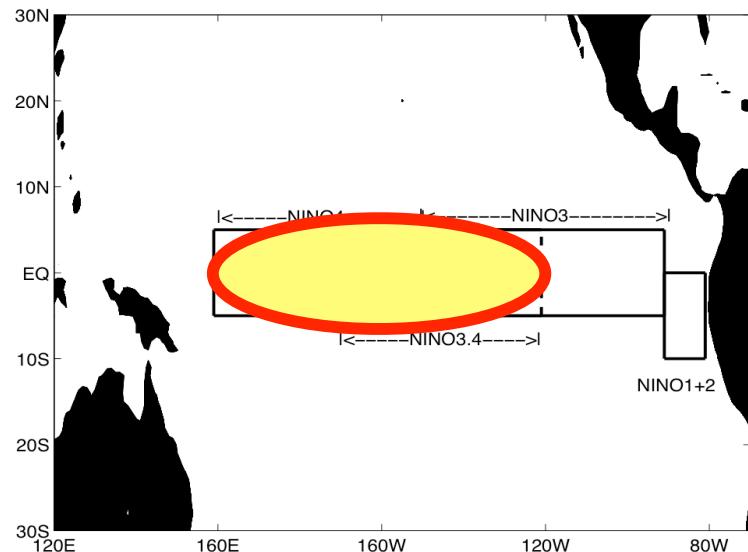
Central-Pacific SST Variability



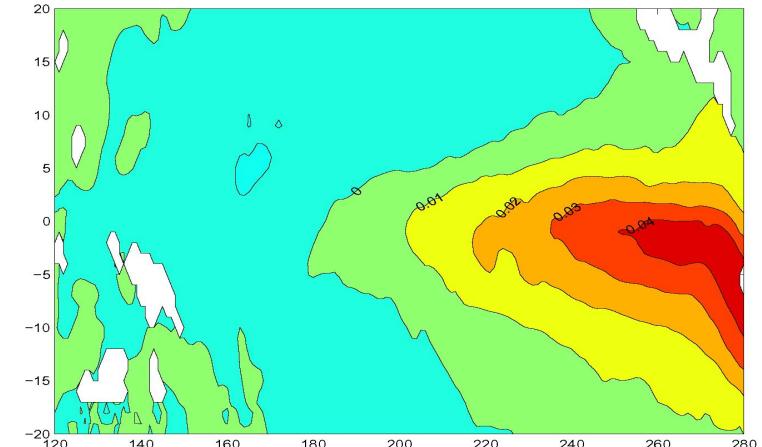
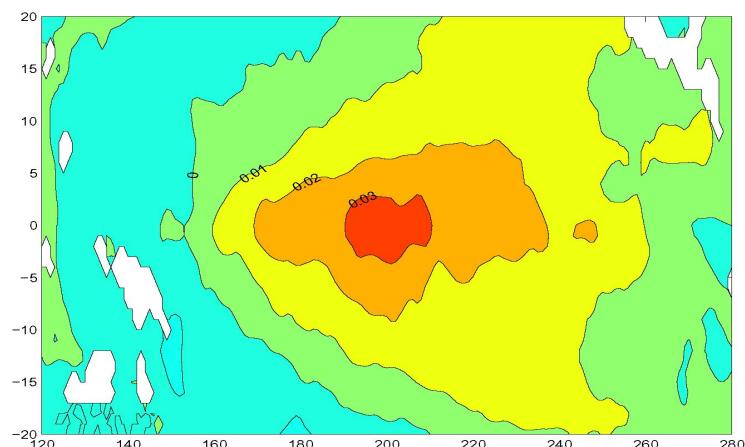
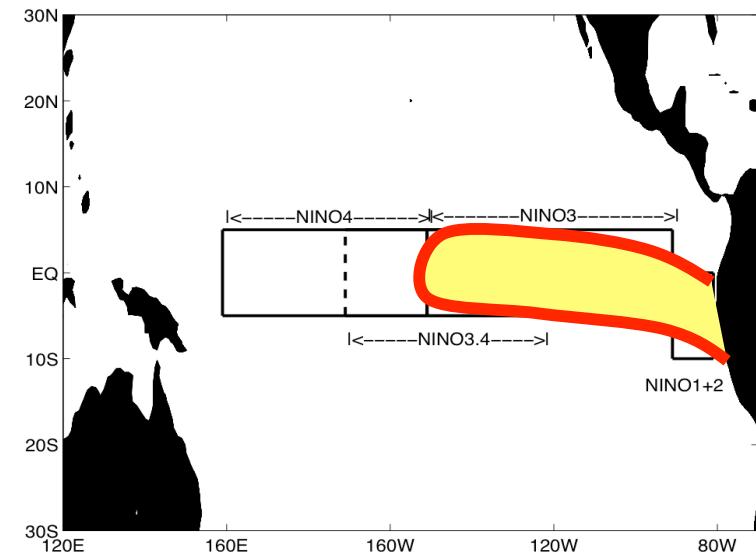
Two Types of ENSO

(Yu and Kao 2007; Kao and Yu 2009)

Central-Pacific ENSO

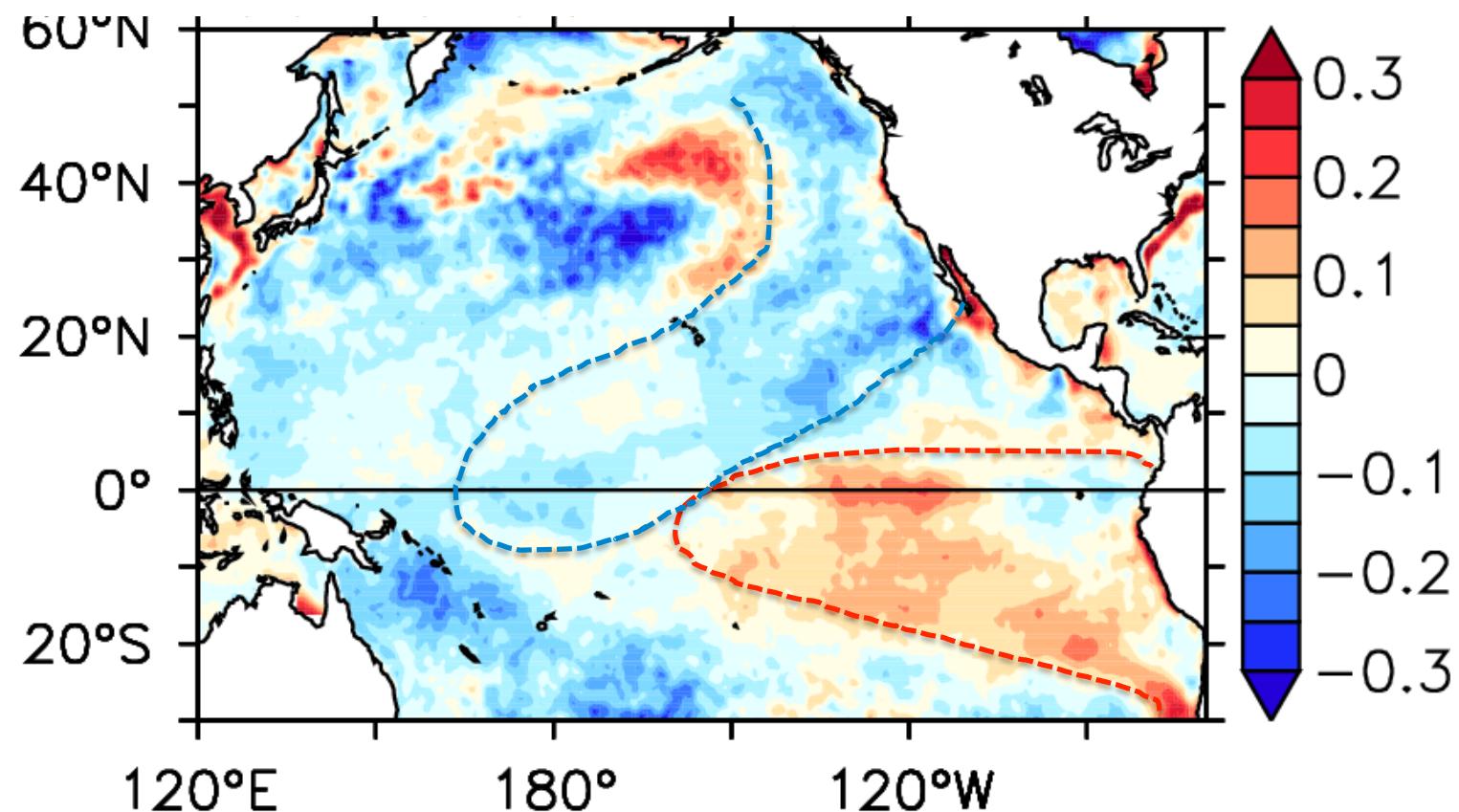


Eastern-Pacific ENSO



Change of SST Variability *Before* and *After* 1990

STD(1979-1990) minus STD(1991-2009)

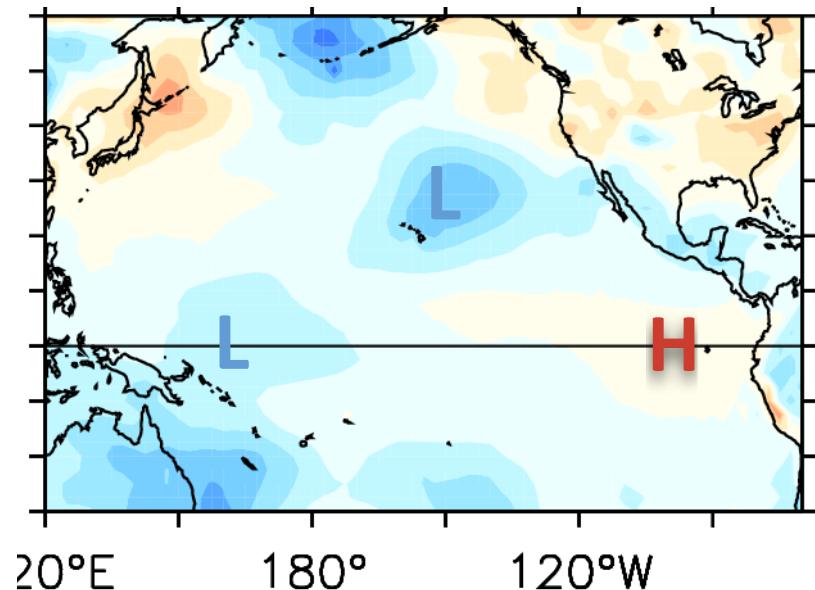


- The decadal change of extratropical-tropical interaction is a possible cause for the shift of ENSO from the EP type to the CP type.
- What causes the change in the extratropical-tropical interaction?

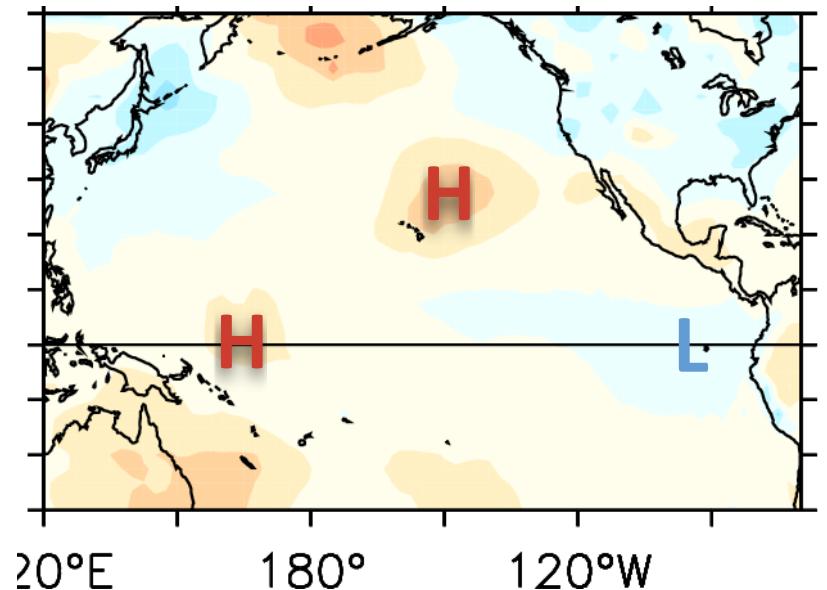
Change of mean SLP *Before and After 1990*

(deviations from the long-term mean)

before 1990 (1979-1990)

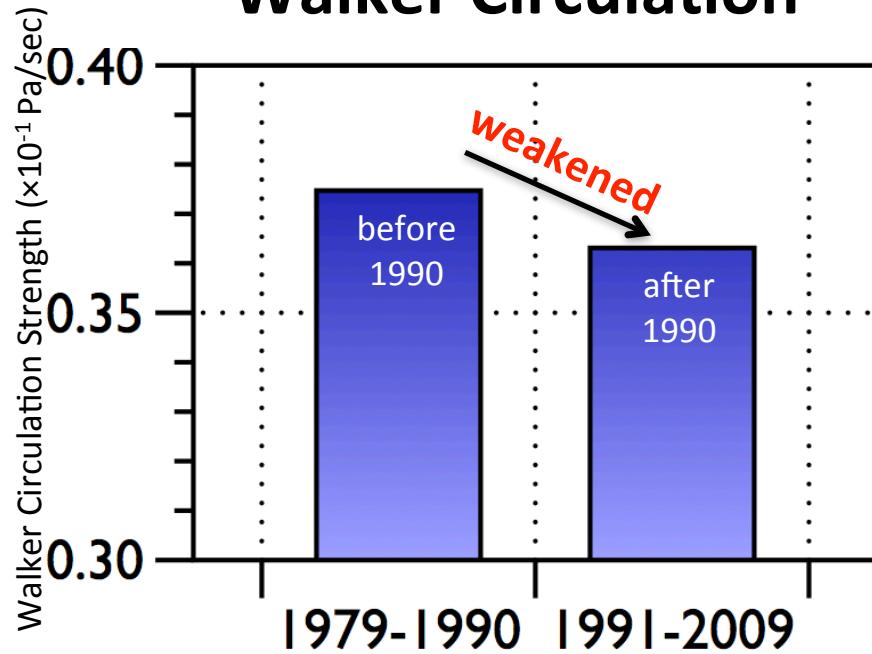


after 1990 (1991-2009)

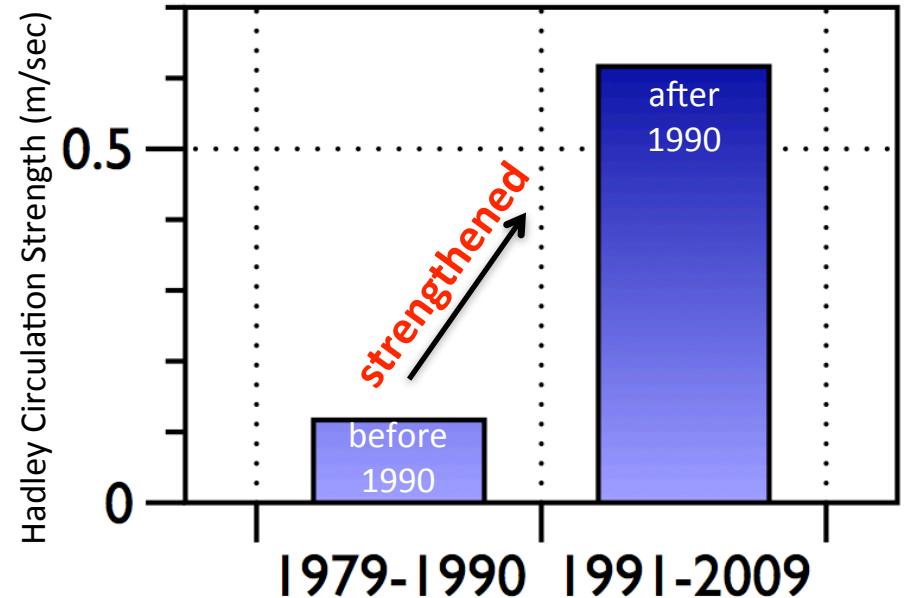


Strength of Walker/Hadley Circulation

Walker Circulation



Hadley Circulation

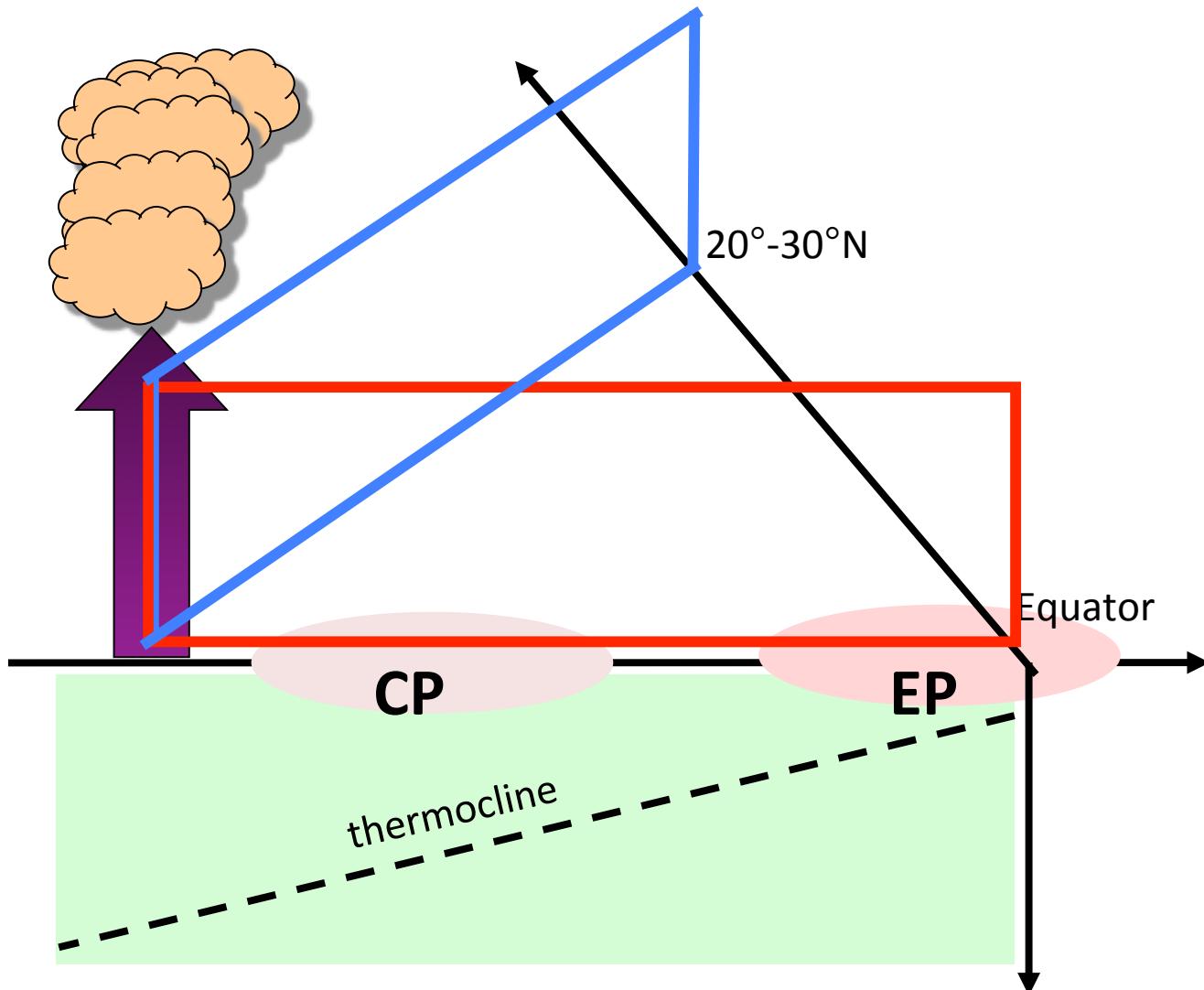


HC : $[v_{200\text{mb}}] - [v_{850\text{mb}}]$ averaged over Pacific $120^\circ\text{E}-80^\circ\text{W}$ along 10°N

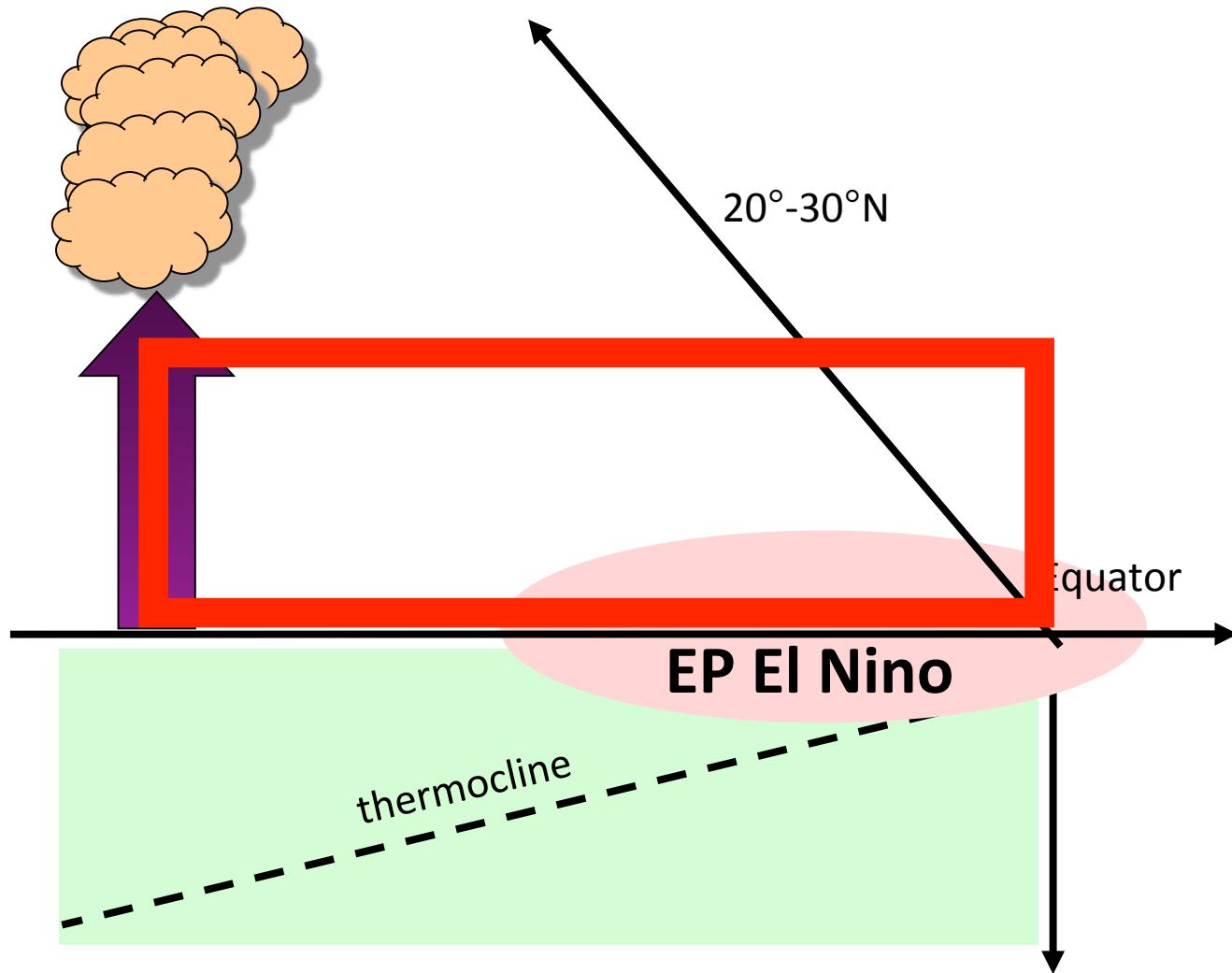
WC : 500mb vertical velocity difference b/w $(180^\circ\text{W}-120^\circ\text{W})$ and $(100^\circ\text{E}-150^\circ\text{E})$ along equator

Oort and Yienger (1996)

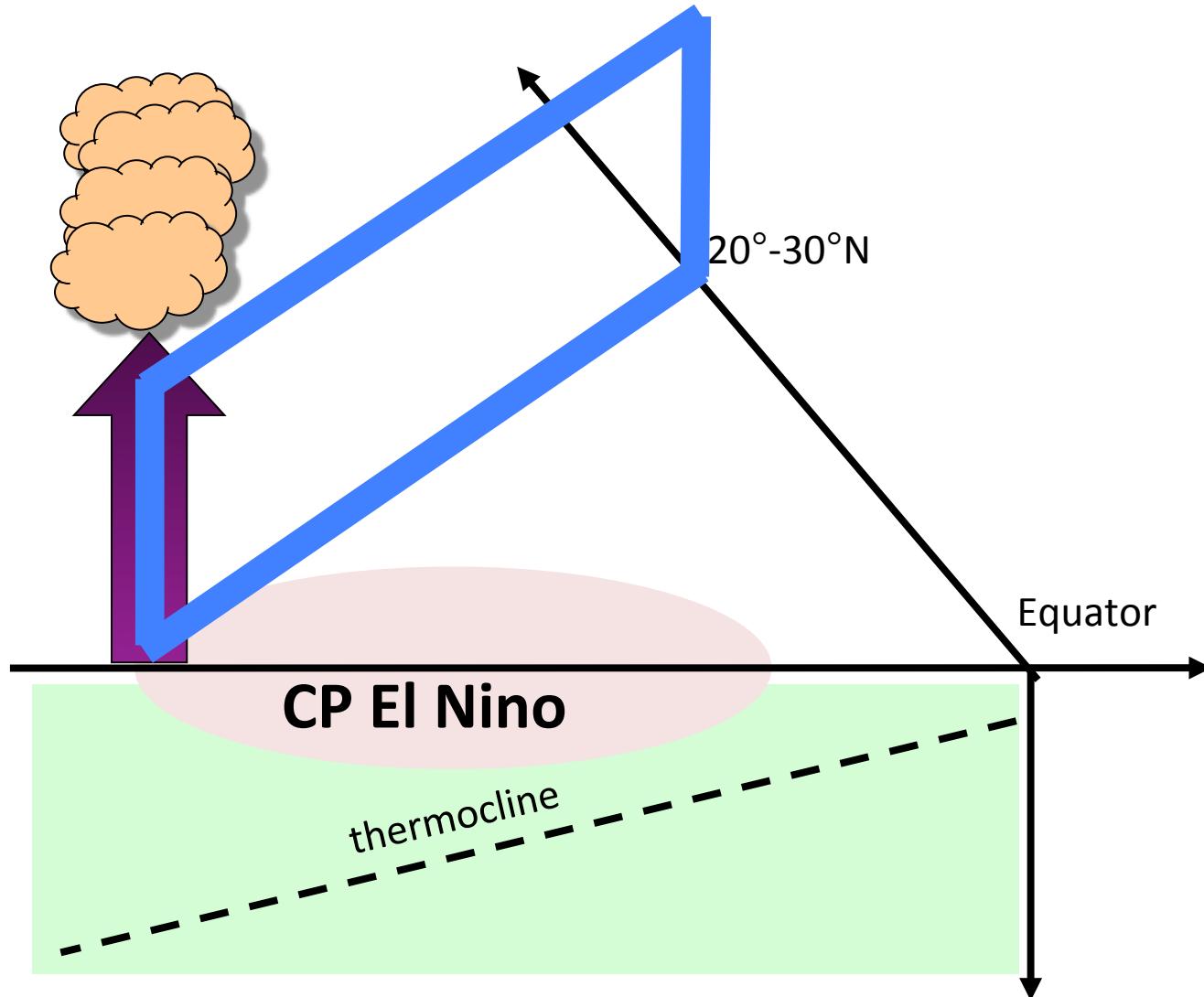
Walker and Hadley Circulations



Before 1990



After 1990

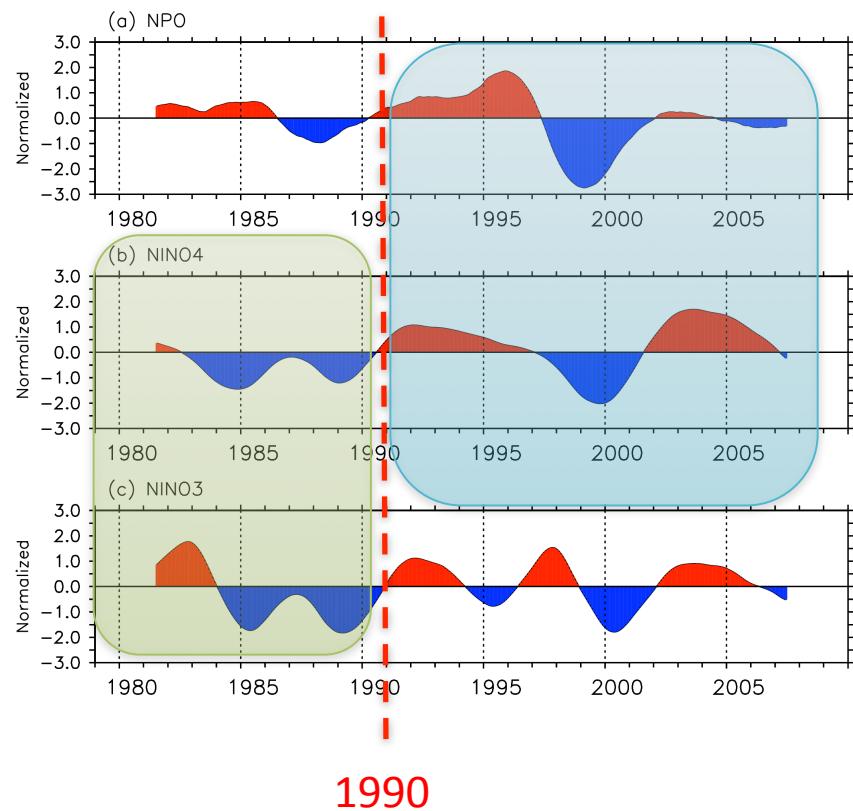


CFS Decadal Run

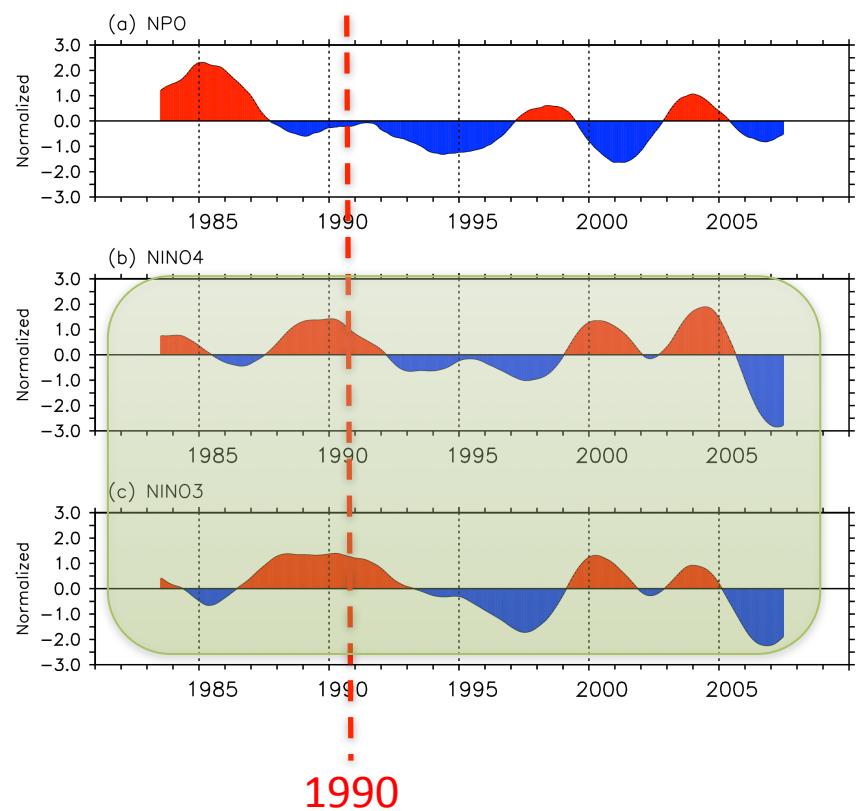
30-Year Run Initialized in Year 1980

NPO and NINO Index in CFSR and CFS DR

CFSR

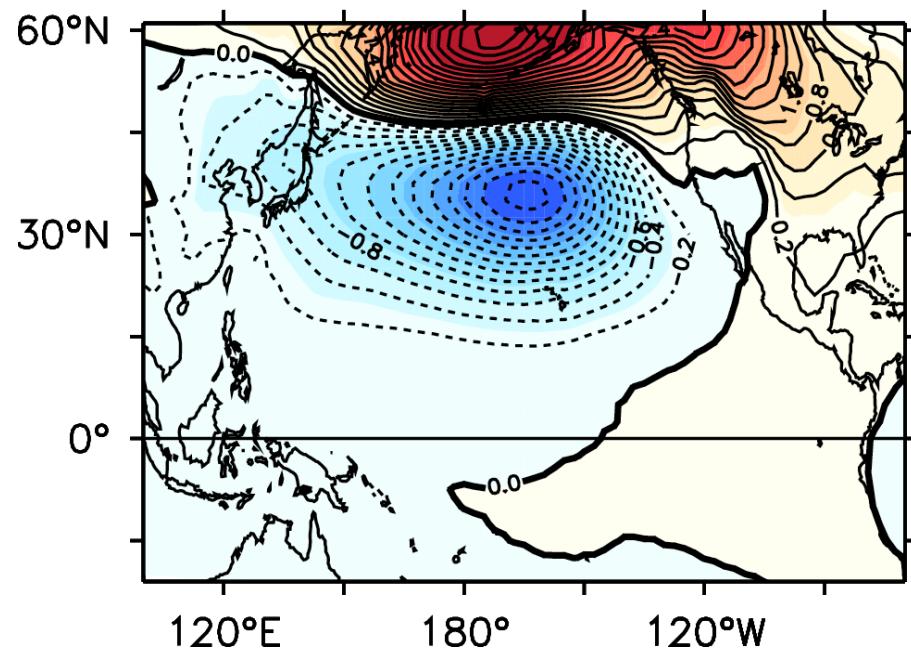


CFS DR

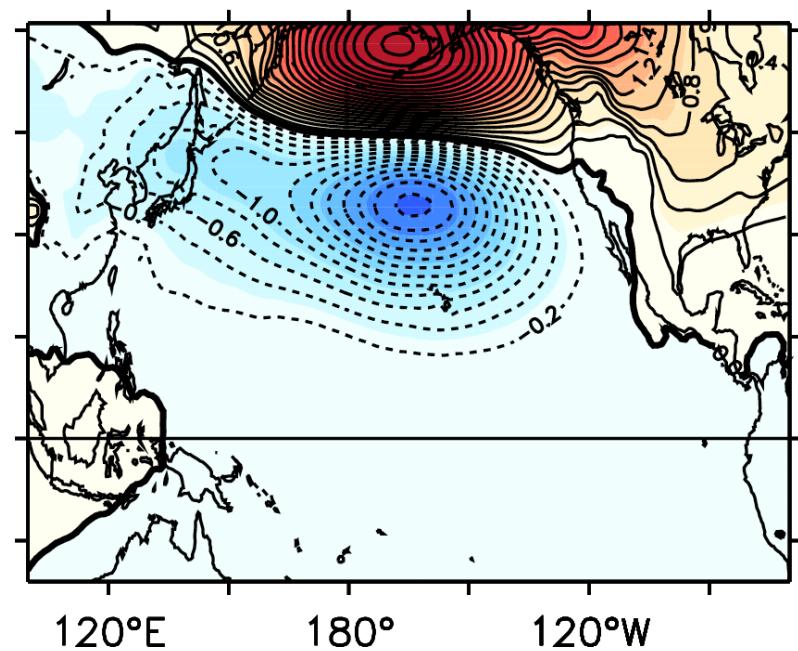


North Pacific Oscillation

CFSR

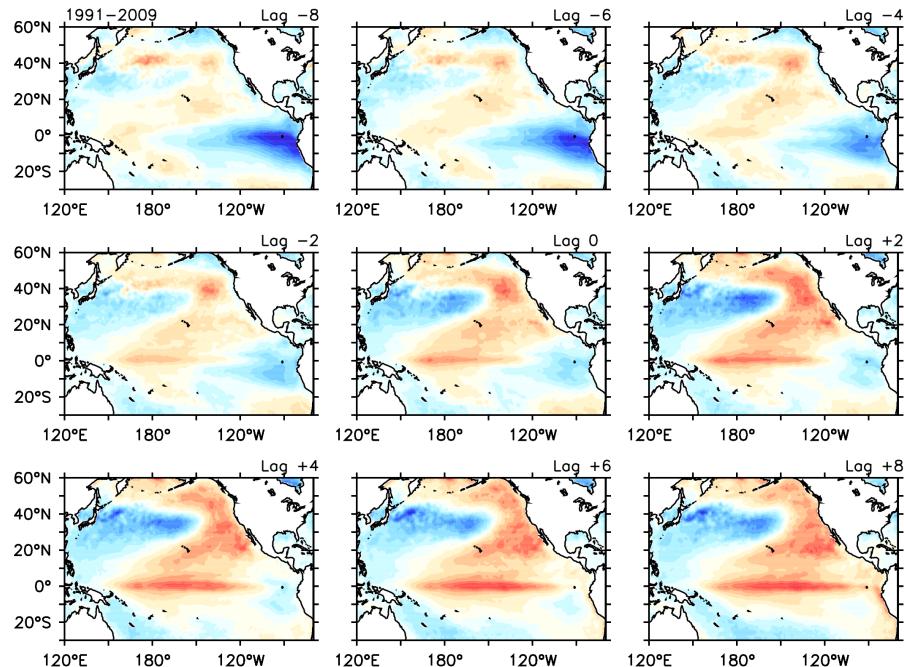


CFS DR

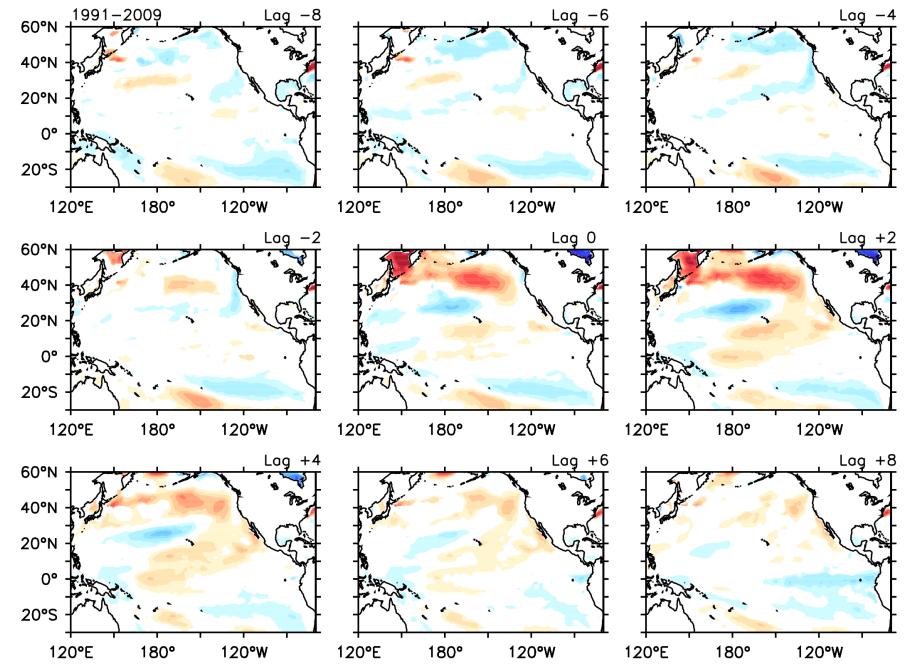


SSTA Regressed onto NPO

CFSR

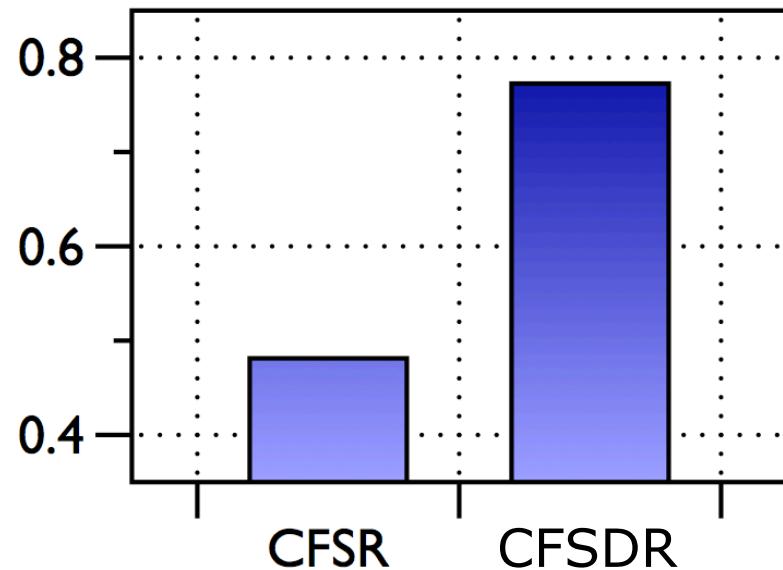


CFS DR

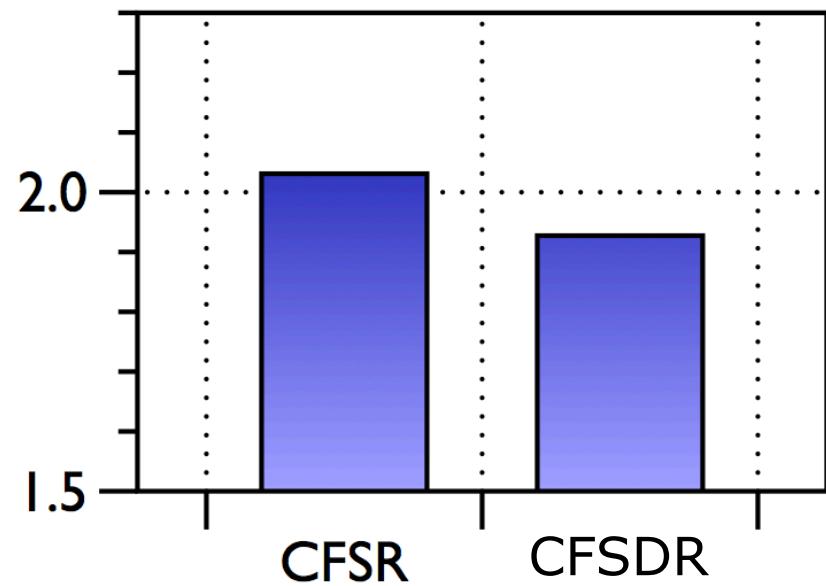


Mean Circulation Strength

Walker Circulation



Hadley Circulation



Summary

- North Pacific Oscillation produced a stronger influence over tropical Pacific SST variations after 1990.
- The stronger influence is a likely cause for the shift of El Nino from the Eastern-Pacific type to the Central-Pacific type.
- The increased influence of NPO over tropical Pacific SST is related to the strengthening of the Hadley circulation and weakening of the Walker circulation after 1990.
- The extratropical influence is undersimulated in the 30-year CFS Decadal Run (initialized in 1980), the exact cause of which is yet to be identified.



..... THANK YOU... 謝謝 ...

Central-Pacific SST Variability

